March 11, 1875.

JOSEPH DALTON HOOKER, C.B., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read :—

I. "On Traumatic Inflammation of Connective Tissue." By G. THIN, M.D. Communicated by Professor HUXLEY, Sec. R.S. Received February 6, 1875.

(Abstract.)

The author, referring to observations recorded in his previous papers, distinguishes in the cornea primary bundles of fibrillary tissue, which are covered by elongated flat cells, layers of quadrangular flat cells (which are analogous in appearance and relative position to the layers of cells described by him as investing the secondary and tertiary bundles of tendon), and the stellate cells. To these he now adds a description of parallel chains of spindle cells, each cell having two processes, one at each end of the spindle, by which it is joined to its fellows on either side. These cells are coextensive with the cornea-substance, and are present in every interspace of the primary bundles, and, consequently, layers in different planes cross each other at an angle.

They can be occasionally seen in thin vertical sections of the fresh frog's cornea, treated in osmic acid; and from such preparations a cell with its terminal processes can be sometimes isolated. They are more easily seen in similar sections which have been 15–30 minutes in half per cent. solution of chloride of gold and then sealed up in concentrated acetic acid and examined 24–48 hours afterwards.

They have no anatomical continuity with the stellate cells.

In the fresh frog's cornea examined entire in serum, the structure, looked at through the anterior epithelium, can be seen to be broken up by clefts, the borders of which have a double contour. These clefts extend from the epithelium to a varying depth into the fibrillary tissue. They are arranged sometimes concentrically, and sometimes in waving lines which give off branches which are narrower as they approach the centre of the cornea. The double-contoured borders are not parallel to the median plane of the cornea, and can be traced only by changing the focus.

From the existence of these clefts the author infers a division of the cornea-substance into compartments equivalent to the secondary and tertiary bundles of tendon.

In inflammation the clefts are much widened, and their finer ramifications become visible. In preparations of inflamed cornea different tracts

of cornea-substance bounded by the clefts are coloured of different shades by chloride of gold, the difference affecting the fibrillary tissue, and more markedly the spindle cells.

The serous contents of the interspaces of the inflamed cornea differ in character from those of the healthy cornea, inasmuch as the former show, more abundantly, the dark granular substance which results from the reduction of the chloride of gold.

In a very early stage of inflammation (after a few hours) the distension of the narrow spaces between the primary bundles and of the wider and more yielding spaces between the lamellæ, corresponding to the larger bundles, favours the action of chloride of gold; and preparations can thus be obtained by this reagent which show that the two kinds of flat cells which cover the respective surfaces are arranged after the manner of an epithelium. The cells thus seen can be identified by their size, contour, and arrangement as those which are isolable from the healthy cornea by warm saturated solution of caustic potash, and which can be seen in preparations sealed up in aqueous humour.

A similar distension occasionally permits the demonstration of the layers covering the secondary bundles of tendon.

That the successful gold reaction, in such cases, is probably due solely to the distension of the interspaces, is inferred from the fact that, in the tendo Achillis of frogs which have died from disease and have been some hours in water after death, the author has obtained gold preparations showing not only the cells of the secondary bundles (Ranvier's cells), but also small groups of the long narrow cells which cover the primary bundles.

In the cauterized frog's cornea, examined in blood-serum after twelve hours' inflammation, portions of the primary bundles are found lying loose on the surface. These detached portions have a nearly constant length, a uniform breadth, sharply defined even borders, are sometimes puckered transversely, occasionally show a faint appearance of longitudinal fibrillation, and are sometimes cut transversely, at one or more points, by straight hyaline lines. They resemble accurately the primary bundles of the neurilemma of the sciatic nerve and the rods of the retina of the healthy frog.

They stain deeply in gold preparations, and are then always puckered transversely.

In gold preparations of the inflamed frog's tongue, isolated primary bundles, identical in appearance and breadth with those of the inflamed cornea, are to be found.

The depth of staining by gold shows that the constituent elements of the primary bundles undergo a chemical change in inflammation.

The author has studied, by means of chloride of gold, the effects of inflammation in the quadrangular and in the long flat cells which cover the bundles in the interior of the cornea, but chiefly in frog-corneæ sealed

up in blood-serum, the latter method being found more certain to give available preparations.

The only appearance observed, anterior to a complete destruction of the cell, was a division of the nucleus into two or more parts. In serum preparations the products of the division assumed the form of circles of highly refractive particles. Similar particles were sparsely scattered in the substance of the cell.

The area of any one circular product of this division was always much smaller than that of the undivided nucleus.

In regard to the stellate cells, the author questions the correctness of the accepted theory, which implies an identity of the cell and its processes with the visible protoplasm. He considers that the refractive particles, which constitute what is visible in the cellular protoplasm, are suspended in a fluid, similarly to the pigment-granules in the pigment-cells as described by Mr. Lister. The phenomenon described by German investigators as "Zusammenballen" of the cell-processes, he attributes to a collection of the protoplasmic particles in the centre of the cell, similar to that which takes place in concentration of pigment. This opinion is borne out by a comparison of gold and osmic-acid preparations. In conditions in which, by the former process, an isolated globular body is seen, osmic-acid preparations show that the anastomosis of the thread-like processes remains complete. Reasoning analogically from the results obtained by gold in other tissues, he infers that it is what may be described as the contents of the cell and processes which stain by that method.

Treatment by osmic acid is the only reliable method by which he has obtained satisfactory preparations showing the stellate cells in the inflamed cornea. The advantages of this mode of treatment are much enhanced by subsequent staining with red aniline, which especially differentiates the protoplasm and processes. Subsequent staining by hæmatoxylin renders the nuclei visible.

The only change, except that of destructive disintegration, observed by the author as a consequence of inflammation in the stellate cells, consists in the anastomosing processes being, in gold preparations, occasionally represented by fine darkly stained lines, on which are a series of small globular swellings placed at short regular intervals, giving any one process an appearance identical with that presented by an ultimate nerve-fibrilla in a gold preparation. The same appearance is also to be seen in osmic-acid preparations, and is suggestive of points of communication between the lumen of the process and the interfibrillary space. (This is the only form in which the author has seen the processes of the stellate cells in inflamed corneæ in gold preparations. They are usually invisible by that process.)

Appearances indicative of a dividing nucleus were rarely seen, and their interpretation is doubtful. Both in respect to the nucleus and the

processes the stellate cells are the most stable of all the cellular elements of the cornea.

Between the layers of the superficial corneal epithelium a network of stellate cells can be seen in serum preparations of inflamed cornea. Indications of similar cells can be seen in gold and hæmatoxylin preparations of the healthy cornea.

In inflammation the cells of this network show a very great increase in size as compared with their appearance in health.

The changes produced by inflammation in the spindle cells may be divided into three stages :—

(*a*) Preparations examined in serum show that the cell-protoplasm has become increased in amount, and that the cell-processes can be distinctly traced. This stage can be observed after twelve hours' inflammation, resulting from slight cauterization in a winter frog. The swelling of the protoplasm is often confined to one or more tracts of the cornea, one of the above-mentioned clefts separating the area of this appearance from that of the normal cornea. The area extends from the neighbourhood of the cauterized part towards the limbus.

(*b*) The swelling of the protoplasm extends along the processes from one cell to the other, a chain of spindle cells being often represented by a long column of protoplasm on which there are very slight constrictions. This description applies to osmic-acid preparations. Deep staining with red aniline and subsequent treatment with acetic acid renders the nuclei visible in this protoplasmic column. This stage is well seen in osmic-acid preparations of a rabbit's cornea which has been 24 hours inflamed by the passing of a thread.

(*c*) With more or less increase in the amount of protoplasm, and with or without its presence in the processes in a granular form, nuclear bodies (resulting from a division of the nucleus) are seen in osmic-acid preparations to be contained in, or partly expelled from, the cell, which are identical in appearance with the red blood-corpuscles seen in the new vessels in the same preparations. This identity in appearance is further maintained by staining osmic-acid preparations with red aniline, in which the nuclear products and red blood-corpuscles are stained a like tint and deeper than the other elements. The author infers from these appearances that in inflammation the nuclei become free bodies, which are equivalent to red blood-corpuscles.

The appearances described by Key and Wallis, Cohnheim, and others as white corpuscles in "Spindelform," are seen in osmic-acid preparations to be spindle cells made more prominent by inflammation.

The "spiessartige Figuren" seen in gold preparations are produced by the protoplasm which immediately surrounds the nuclei of the spindle cells being visible, whilst from the mode of preparation the connecting processes are invisible.

White blood-cells in the inflamed cornea can be identified with most

certainty in osmic-acid preparations. They are found in groups in the wider spaces, in rows in the nerve-channels and between the primary bundles (corneal tubes of Bowman), and in large numbers in the tracts between the larger bundles. They are mostly round, sometimes club-shaped, never pointed at two extremities as an elongated shuttle-shaped mass (that is, never *spindelformig*, *spiessartig*). A small minority consist of a double body formed by two rounded globular masses joined by a smooth isthmus. When stained by hæmatoxylin, nuclei are found in either end, but not in the isthmus. The author infers that we have here a corpuscle in process of division.

In rabbit-corneæ, in which inflammation has lasted about a week, some white corpuscles are seen with uneven contour; and bulging outwards from, or lying close beside, them are bodies evidently nuclear, and which are affected by osmic acid and subsequent staining with red aniline, in a manner identical with the red blood-corpuscles seen in blood-vessels in the same preparation. The identity of the escaped nuclei with red blood-corpuscles is shown by a comparison of their respective size, evenness, colour, and contour.

The author infers a production of red blood-corpuscles in inflammation from the nuclei of the white blood-cells.

In observations on human blood, and that of the mouse, by staining with hæmatoxylin, he has found that while the great majority of the red corpuscles do not quickly stain in a weak solution, there are some which at once stain a deep blue, and that there are white corpuscles in which a narrow protoplasmic margin encloses a deep blue nucleus similar in contour and size to the stained red corpuscles. Amongst the red corpuscles of the frog are a minority which are recognized as being red corpuscles by their size, smooth contour, and absence of granulation, but in which there is no hæmoglobin, and the nucleus quickly stains blue in solution of hæmatoxylin, like that of the white cells.

Transitions occur in which a less and less capacity of staining on the part of the nucleus takes place, *pari passu* with an increase in the colour characteristic of hæmoglobin in the body of the cell. In the fully developed red corpuscle, the nucleus stains only after it has been for some time in contact with a weak solution of hæmatoxylin.

The author has observed in the blood of the mouse fœtus the nuclei of the nucleated red blood-cell escape from the larger cell, and then become indistinguishable in form and appearance from the small red corpuscles of the mature animal present in the blood under examination.

These observations, taken in connexion with the bodies that are formed in the spindle cells and white corpuscles in inflammation, support, as the author believes, the doctrine of Wharton Jones, in regard to the formation of the red blood-corpuscles.

The mode of formation of capillary blood-vessels he believes to be identical in inflamed and in fœtal tissue. In studying this subject he

has found special advantages from the use of osmic acid, with or without subsequent staining in hæmatoxylin. The stages in this formation are as follows:—

(*a*) The spindle cells enlarge and contain several nuclei which can be identified, whilst within the cell, as being of a similar nature to red blood-corpuscles. A current of blood-plasma from the nearest vessels passes, at the same time, into the interfibrillary space in which the spindle cells lie.

(*b*) The nuclei escape from the spindle cells into this space, where they are indistinguishable in appearance from the ordinary red blood-corpuscles.

(*c*) By a process of diapedesis the formed elements of the nearest blood-vessels pass into this space and the circulation is established.

Various appearances lead the author to suppose that the fibrine of the plasma solidifies on the outer surface of the current and forms the substratum of the new vessel, and on this substratum the white blood-corpuscles fix themselves and spread out as an epithelium.

From interfibrillary spaces in the inflamed cornea, in which formation of blood-vessels was actively taking place, the author has isolated white corpuscles in various transition stages towards the appearance and shape of epithelium; and, from rapidly enlarging vessels, cells which, from their form, he believes to be transitionary to that of smooth muscular fibre.

As the new capillary forms, the enlarged spindle cells decrease to their ordinary size.

In preparations of blood-serum of the frog sealed up, after a few days, the hæmoglobin may be observed to assume special forms inside the corpuscle, or to disappear from it, and so produce changes in the appearance of the corpuscle identical with those described by Arnold as taking place in the tongue of the living animal after diapedesis.

The above observations were made chiefly on the cornea of the frog and rabbit; and the inflammation was mostly produced by solid nitrate of silver, the passing of a thread, and the application of methylated alcohol.

In the winter frog (*Rana esculenta*), cauterized in the centre of the cornea, the first entry of white corpuscles attributable to inflammation was observed, after 48 hours, in the wider spaces near the limbus. After 4 days, they could be observed in considerable numbers, and 2–6 could be seen in one so-called space (*lacuna*).

II. "Report on Observations of the Transit of Venus made at Luxor, Upper Egypt, 9th December, 1874." By Vice-Admiral E. Ommanney, C.B., F.R.S. Received February 11, 1875.

Owing to the kindness of Professor Auwers, of Berlin, who placed his heliometer at my service, I was enabled to make the following notes of time and phenomena during the time of egress.